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Naval War College
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ACCESSIBILITY OF CONTINENTAL SUB-SAHARAN AFRICA AND SOUTHWEST ASIA PORTS TO AFLOAT PREPOSITONING FORCE SHIPS, MARITIME PREPOSITIONING FORCE SHIPS, AND READY RESERVE FORCE SHIPS -- IMPLICATIONS FOR THEATER LOGISTICS OVER THE SHORE AND LOGISTICS PLANNING

by

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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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Abstract of

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This review examines accessibility of Sub-Saharan Africa and Southwest Asia ports to APS, MPS, and RRF ships, reviews LOTS systems, and examines theater logistics planning issues regarding access via unimproved sites when improved ports are not available. The data show that commanders must give careful consideration to both which ports will be able to provide logistics support and which specific ships will be able to serve the port(s) selected and must consider the use of LOTS for theater sustainment as a distinct possibility. LOTS planning issues discussed include the relationship to amphibious operations, beach survey, timeliness, priority of LOTS system movement, alternatives to LOTS priority sealift, availability of the right types of equipment in theater, and factors limiting LOTS operations. This review provides a jumping off point for more detailed examination of individual ships versus ports. It indicates the magnitude of the port access problem but does not attempt to solve it for each situation. Similarly, no attempt has been made to detail LOTS transfer ratios, etc. This review focuses on issues with which theater commanders must concern themselves in order to determine the overall level of effort necessary to logistically support their operations.

TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

The first purpose of this review is to examine and draw conclusions regarding the accessibility of continental sub-Saharan Africa and Southwest Asia ports to ships owned or chartered by the United States government to provide quick response military logistics support in the event of a contingency. For this review sub-Saharan Africa is considered to be littoral states from Senegal south and then east and north to the Red Sea coast of Egypt. Southwest Asia is defined as the remainder of Red Sea littoral states, Arabian Peninsula littoral states, Persian Gulf littoral states, and Pakistan. The following ship categories are included in the review.

- Afloat Prepositioning Force Ships (APS)
- Maritime Prepositioning Ships (MPS)
- Aviation Logistics Support Ships
- Fast Sealift Ships (FSS)
- Ready Reserve Force Ships (RRF)

Table 1 lists by category, function, class, and name all ships in the above categories.[1]

The second purpose of this review is to briefly look at the types of logistics over the shore (LOTS) systems available to supplement, or replace, the use of developed port facilities and to discuss theater logistics planning issues relating to LOTS. It is of considerable importance to review LOTS operations in theater logistics planning given the likelihood of LOTS operations shown to be necessary by the port accessibility conclusions in this review.

BACKGROUND[2]

The determination of port accessibility for the purposes of this review is a two step process.[3] The first step is determination of a ship's ability to safely enter a port (i.e., navigational safety -- depth of water, availability of pilots and tugs, etc). Facilities listed as ports in PUB 150 and Lloyd's Ports that are in fact off-shore islands and oil terminals, single point moors, and other such facilities have been included for consideration as ports only when information indicated they had a significant land transport connection (e.g., causeway) that would allow movement of material to supported forces without the need for reembarkation on additional shipping for transhipment. The second step in determination of accessibility is assessment of a ship's self sufficiency. Self sufficiency is a ship's ability to discharge its cargo without other assistance. To achieve this condition, the implicit assumption in this review is that the ship must be pierside and able to off-load its cargo with either onboard equipment (e.g., booms, cranes) or indigenous assets (e.g., side loadable warping tugs) that it has brought with it.

PORT ACCESSIBILITY CRITERIA

To determine accessibility the characteristics of each ship class must be examined. The most important characteristics, for the purpose of this review, are detailed at Table 2.[4] The key navigational characteristics likely to limit a ship's ability to safely enter a port are its length, draft, and maneuverability in confined spaces. In most cases for the ships considered in this review the tonnage to shaft horsepower ratio is less than 1:1. Based on the author's experience this situation results in the need to use tugs for mooring and unmooring in all but the most optimum of ship handling conditions, particularly for larger single screw ships. The author's experience also shows that mooring ships of this size can be done, up to a point, with only one tug in favorable conditions of berthing space, current, wind, and shipping density. The point selected for single tug use was 30,000 tons full load displacement. Full load displacement was utilized based on the assumption that as much cargo as possible would be loaded on these ships in order to maximize the quantity of material delivered to the theater as soon as possible. Ships with displacements greater than 30,000 tons have been assigned a requirement for two tugs. In the case of installed thrusters or twin screws the author's judgement was applied to assign a required number of tugs.

In general, under less than excellent conditions the tug requirements assigned herein may be understated. In conditions of hot war or immediacy of need the use of lesser numbers of tugs may be a fact of life and some ship/pier/cargo damage may be acceptable. Another variable, impossible to accommodate in this review, is that the ship master's familiarity with his ship's handling characteristics and his personal expertise will also have a bearing on ship mooring safety. The criteria established herein are considered prudent under a wide range of circumstances and useful to define wherein potential planning problems may lie. Assumption of greater levels of risk and potential damage will in the final analysis rest with the operational commander.

The requirement for a harbor/berthing pilot is also implicit, although not noted in Table 2. This is considered necessary in order to ensure ship safety on entry into an unfamiliar harbor. In most cases pilotage is compulsory in any case, and in all cases where tugs are available pilots are also available. Acceptance of increased risk vis-a-vis potential lack of pilots in a combat zone, hot war, and urgency of need will, as discussed with respect to tugs, rest with the operational commander.

The next key ingredient in accessibility determination is a ship's ability to off-load once it has arrived at its destination. Port facilities can play an important role, but contingencies do not necessarily occur where fully developed ports exist, or it is possible that port facilities may have been damaged through combat or terrorist action prior to ship arrival. Therefore, examination of shipboard cranes, booms, elevators, ramps, etc. is necessary, particularly since these ships will be the first ones to arrive in the theater, and their arrival will probably precede any major port improvements that could be generated later in a contingency. It is also important to note that for this review pierside berthing was considered a requirement. This constraint was established in order to determine the magnitude of the requirement that could exist for LOTS operations.

An examination of each ship's individual cargo handling characteristics was completed, and as shown at Table 2 all ships were found capable of off-loading their cargo without the additional requirement of port support equipment. This is not to say that off load would not be faster by using shore facilities, but the point is that, speed not considered, off-load with just ship's equipment is possible in each case. With respect to lighter aboard ship (LASH) vessels it was assumed that in the worst case they could employ the same tugs to move the lighters that were used to moor the ship if indigenous self propelled lighterage was not brought by the LASH vessel. Recapitulation of shipboard cargo handling equipment has not been undertaken herein to avoid the voluminous data that would have to be added.

To complete the review an examination of port characteristics is required. Various handling facilities of some type are available in virtually every accessible port. Numbers of berths that can accommodate the ships reviewed also varies by port. However for the purpose of this review port loading and rates of cargo transfer are not being considered. The relevant issues are: can the ship get into the port and once there can it get its cargo off.

Not of key importance to RRF port utilization (since all ships are self sufficient) but of importance to theater commanders is that auxiliary crane ships (TACS) are contained in the RRF. These ships are equipped with several large cranes that give them the ability to not only off-load their own cargo, but also to lift material from non-self sufficient ships and place it ashore. This allows even unimproved or damaged ports to accept a variety of commercial vessels (e.g., container ships) for contingency support as long as one or more TACS is sited there and port geography (e.g., berth widths) permits entry and berthing of the commercial vessels alongside a TACS vessel. TACS also provides the capability to off-load other ships at anchorage and then transfer that material to lighterage for subsequent transport ashore via LOTS systems.

SUMMARY OF PORT ACCESSIBILITY DATA

Since all ships in this review are self sufficient the driving factor in port accessibility is port geography. Table 3 shows the limiting factors for each port and displays those ports that were evaluated as inaccessible. With respect to geography the most critical feature is normally water depth. In almost every case where a port is determined to be inaccessible it is due to shipping draft constraints. Egypt is a notable exception in that three otherwise accessible ports have no tugs and/or pilots available.

Table 4 provides a compilation of results by ship category, function, class, country, and port. In Table 4 Dakar, Senegal is listed twice due to significant seasonal water depth variations. This yields a total of 45 ports for "counting" purposes for sub-

Saharan Africa, 50 ports for Southwest Asia, and a total of 95 ports.

With respect to accessible ports, in 24 of 95 instances draft is the only limiting factor (either with respect to port entry or pierside berthing). In six cases ship length is the only limitation. Of all limitations to accessible ports 59% are draft, 36% are length, and 4% are tug/pilot related. Of the entire list of ship classes versus all accessible ports 61% of the Table 4 grid is filled for Africa, 70% of the grid is filled for Southwest Asia, yielding a total grid fill of 66%.

In sub-Saharan Africa, each of the 28 littoral nations has at least one port and there are a total of 125 ports listed for all nations. Due to the various constraints shown in Table 3 only 45, or 36%, of these ports are accessible to the ships in this review. The overall result is that contingency forces ashore in the following nations cannot be supported logistically by sea through an improved port:

Guinea - Bissau
Cameroon
Equatorial Guinea
Cabinda (Angola)
Zaire

Compounding this situation is the fact that 15 (33%) of the accessible ports can accommodate less than one half of the classes of ships. Included in this list of 15 ports is the only (or all) port(s) for:

Gambia
Ghana
Nigeria
Namibia
Tanzania
Egypt

A more detailed look shows that the APS, MPS, and FSS are all but excluded from access (8% class access) to these additional six nations. Further, with respect to the APS, MPS, and FSS in general, there are only 8 (18%) ports in the sub-Saharan region that allow 100% class access. These "all class" ports are confined to only Liberia, Gabon, Angola, and South Africa.

A similar view of southwest Asia shows that each of the 13 littoral states has at least one port, with a total of 55 ports listed for all nations. The accessibility ratio is much better, however, with 50 of 55 (91%) ports accessible and no nations excluded from port access. There are 14 (28%) accessible ports that can accommodate less than one half of the classes of ships, but there is no nation in which all of its ports are so constrained. There are 23 (46%) ports which can accommodate all classes of vessels, and distribution is such that only Yemen, Qatar, and Pakistan do not have an all class capability.

With respect to ship categories and classes the below data has been derived regarding sub-Saharan Africa.

- APS: The APS is excluded from seven ports (for APS purposes Gambia and Egypt are also added to the list of five nations inaccessible by sea). Only one class of eight can serve an additional eight ports, only two classes can serve an additional nine ports, and only three classes can serve one additional port. This results in the APS being significantly limited in its ability to quickly put material in place in 56% of the accessible ports. It has full access to only 8 (18%) ports.

- MPS: The MPS is excluded from 16 ports (for MPS purposes Gambia, Nigeria, Namibia, Tanzania, Somalia, and Egypt are also added to the list of five nations inaccessible by sea). Only one class of three can serve an additional six ports. This results in the MPS being significantly limited in its ability to quickly put material in place in 49% of the accessible ports. The MPS has full access to only 20 (44%) ports. The Bobo class is able to enter more ports than both the Hague and Kocak classes, and the Hague class is able to enter more ports than the Kocak class.

- FSS: The FSS is excluded from 33 (73%) ports (for FSS purposes Gambia, Guinea, Sierra Leone, Ghana, Togo, Benin, Nigeria, Congo, Namibia, Mozambique, Tanzania, Kenya, Somalia, Djibouti, Ethiopia, and Egypt are also added to the list of five nations inaccessible by sea).

A similar review of ships categories with respect to Southwest Asia shows the below results.

- APS: The APS is excluded from nine ports, only one class in eight can serve an additional two ports, only two classes can serve an additional seven ports, and only three classes can serve an additional one port. This results in the APS being significantly limited in its ability to quickly put material in place in 38% of the accessible ports. Distribution of limited ports is such that each nation has at least one port not in the foregoing categories. The APS has full access to 23 (46%) ports.

- MPS: The MPS is excluded from twelve ports, and only one class of three can serve an additional ten ports. This results in the MPS being significantly limited in its ability to quickly put material in place in 44% of accessible ports, severely constraining MPS response to a contingency in Yemen. The MPS has full access to 28 (56%) ports yielding at least one port with full MPS access in all nations, except Yemen, in the Southwest Asia region. Accessibility by class for the Bobo, Hague, and Kocak classes was similar to that discussed regarding Africa.

- FSS: The FSS is excluded from 25 (50%) ports, which precludes its access to both Yemen and Pakistan.

A tabular display of the above data is provided below (data is in percentages).

APS Percentages

	Ports Excluded	Ports Less Than Half Service	Total	Nations Excluded	Ports Full Access
Africa	16	40	56	25	18
Southwest Asia	18	20	38	0	46

MPS Percentages

	Ports Excluded	Ports Less Than Half Service	Total	Nations Excluded	Ports Full Access
Africa	36	13	49	39	44
Southwest Asia	24	20	44	0	56

FSS %

	Ports Excluded	Nations Excluded
Africa	73	75
Southwest Asia	50	15

General data relating to both sub-Saharan Africa and Southwest Asia is provided below:

- Roll on/Roll off access in the RRF is generally high except where almost all other ship classes are also excluded.

- LASH in the APS is useable in only 34% of accessible ports (20% in Africa) and RRF LASH vessels are usable in only 39% (27% in Africa) of accessible ports.

- Oil Tankers cannot use 33 (35%) accessible ports, and an additional 15 (16%) ports are inaccessible to more than half of the tanker classes -- a total of 48 (51%) ports for which tanker support is significantly limited.

- The smallest, shallowest draft classes, two gasoline tankers and one troop ship in the RRF, could access 98% of all ports, but these capabilities by themselves are essentially useless.

- Classes with poor port accessibility:

Class	Function	Africa (≤33%)	SWA (≤50%)
Overseas	Tanker (RRF)	29	--
Overseas	Tanker (APS)	29	50
SL-7	FSS	27	50
SeaBee	Cargo Barge Carrier (RRF)	24	50
C8-S-81b	LASH (APS)	22	46
C9-S-81d	LASH (APS)	18	46
C9-S-81d	LASH (RRF)	18	46

- Classes with 85% or better port accessibility:

Class	Function	Africa (%)	SWA(%)
Alatna	Gasoline Tanker (RRF)	100	98
Tonti	Gasoline Tanker (RRF)	100	98
Barrett	Troop Ship (RRF)	98	98
C3-S-38a	Break Bulk (RRF)	91	96
C3-S-33a	Break Bulk (RRF)	91	92
Meteor	Roll on/Roll off (RRF)	91	90
C3-ST-14A	Roll on/Roll off (RRF)	87	88
S5-S-MA49C	Troop Ship (RRF)	87	88

PORT ACCESSIBILITY DATA EVALUATION

The data show that, in general, sealift support for contingencies in Southwest Asia will be relatively easier to provide than for sub-Saharan Africa. Southwest Asia has a greater number and percentage of ports that can accommodate all ship classes and a lesser number and percentage of ports that are most significantly constrained vis-a-vis ship classes. Saudi Arabia has excellent port coverage on both the Red Sea and Persian Gulf with respect to both range of class access and numbers of ports. It is also the largest nation on the Arabian peninsula. The combining effect, from a sealift supportability standpoint only, is that if the operational commander is forced to trade space for time in Saudi Arabia he may be able to do so successfully.

The situation with respect to sub-Saharan Africa is not nearly so sanguine. Nearly 40% of the nations are severely constrained with respect to sealift supportability across a developed waterfront. Class accessibility fluctuates significantly, with only South Africa having excellent access with respect to range of classes and numbers of ports, and Liberia and Angola having two ports with good range of access. Additionally, with the exception of Port Sudan the entire east coast of Africa is inaccessible by the FSS.

The ships relied on for the most rapid, flexible sealift response, the APS, MPS, and FSS are in general the most constrained by littoral imposed factors, particularly with respect to sub-Saharan Africa. The data also indicate the efficacy of grouping the MPS in squadrons by ship class to the extent possible in order to maximize accessibility probability and the likelihood that the supported marine expeditionary brigade will receive all of its equipment.

Cargo barge carrying ships and oil tankers, in addition to the FSS, are the most constrained classes due to their size. Conversely, the smaller, older, and less capable ships in the RRF have the least problem accessing ports. This review shows that based on accessibility there is merit to retaining a small ship (in relative terms) capability in support of contingencies. This is at variance, however, with current commercial trends toward building larger ships in order to lower unit cost. It is also at variance with possible U.S. Transportation Command plans to procure a very large cargo carrying vessel.

Finally, the fact that in Table 4 only a total of 61% of the ship class to port grid was filled for sub-Saharan Africa and 70% of the grid was filled for Southwest Asia indicates that theater commanders must carefully consider which ships to order readied out of the RRF in support of any contingency. These data also indicate that theater commanders must consider the use of LOTS for theater logistics sustainment as a distinct possibility under almost any likely contingency scenario.

LOGISTICS OVER THE SHORE (LOTS) CONSIDERATIONS

It is generally theorized that in an overseas contingency approximately 95% of the material necessary to support U.S. forces ashore will be transported by sea. This is particularly true of large equipment such as tanks and helicopters not easily transported by air and large quantities of support material such as ammunition, food, and bulk petroleum products (petroleum, oil, and lubricants - POL). The data in the previous section indicates that unless the U.S. is fortuitous in the locations where crises develop one, or both, of the following two items will be a likely necessity to get the required quantities of material and equipment ashore in the full range needed to support a crisis response:

- A second nation willing to allow U.S. use of its port facilities as a transhipment point for throughput of material to U.S. forces in a neighboring nation.
- The ability to move material ashore from sea without the benefit of improved port facilities.

The first item, coalition partners, may or may not be feasible. U.S. interests in a particular situation may or may not harmonize with another nation's, and even if they do support and/or assistance of any magnitude to U.S. forces may not be politically acceptable to the foreign government. In Desert Shield/Storm U.S. interests and those of others coincided and U.S. use of their excellent port facilities for material transhipment was available. In Operation El Dorado Canyon the

U.S. was unable to obtain even clearance through French airspace to help support military action against Libya.

The net result is that the unknowability of the conditions surrounding a crisis involving employment of U.S. forces globally in general, and in sub-Saharan Africa and Southwest Asia specifically, dictates that theater commanders be mentally and physically prepared to move material ashore without the benefit of improved port facilities (i.e., LOTS operations). This requirement covers the full range of equipment and other materials from tanks and earth movers to spare parts and water. This is driven by the previously discussed generally low availability of fully suitable ports in the regions under review, the potential for enemy or terrorist damage to existing port facilities rendering them unusable, and just the wide geographic dispersion of support capable ports vis-a-vis potential involvement points. This requirement is highlighted by the fact that from Richard's Bay, South Africa to Djibouti there is only one port on the entire east African littoral (Mombasa, Kenya) in which over 75% of the ship classes have access. From Djibouti to the Suez Canal there is only one more port equally as capable (Port Sudan, Sudan). Similarly in Southwest Asia the distance from Al Aqebah, Jordan to Yanbu, Saudi Arabia (the next available port) is over 400 miles.

In view of the foregoing it is interesting to note that Joint Chiefs of Staff (JCS) doctrine in Joint Test Pub 4-0 spends two sentences on port related considerations and does not discuss the possibility/need for LOTS at all. By contrast, a paragraph each are devoted to such things as "Real Estate Requirements," "Assignment of Facilities", and "Mortuary Affairs."[5] Access (i.e. port selection) and LOTS should be given greater, or at least some, doctrinal emphasis in this publication covering general doctrinal concerns, giving further reference to other publications having more specific data as appropriate -- Chapter III, paragraph 2.a(2) of Joint Test Pub 4-0 would be a logical place for this information.

As discussed and exemplified in the reference material used for this review, including JCS Pub 4-01.6,[6] LOTS operations are generally developed in the context of a follow-on to an amphibious landing, the inference being that some degree of beach organization and preparation will have already occurred. As alluded to above this may not necessarily be the case. Depending on the type and location of the contingency it is conceivable that the LOTS operation could be the first beach activity in establishment of the initial logistics base in support of airborne forces, other U.S. Army or Air Force troops, or Marines who may be inserted in a non-amphibious manner or by LCAC. Leap frogging of theater support to a secondary logistic site in support of advancing troops is also a potential LOTS task. In any case, the point is that the theater commander cannot assume that seaborne logistic support will arrive at a prepared beach site with some amount of equipment already in place to support initial operations. Causeway sections (powered (CSP) and nonpowered (CSNP)) and side loadable warping tugs (SLWT) from amphibious ships may not be available to support the initial logistics effort. Further, doctrine prescribes that amphibious shipping will take with it its indigenous equipment when it departs the area for other operations, leaving sustainment shipping (the RRF, et.al.) with the necessity to bring with it the things it needs to support the logistics operation.[7]

In addition to equipment concerns, the theater commander must take into account the wide range of beach preparation issues in generation of logistics support requirements if no preceding amphibious assault has taken place. Considerations such as beach gradient, beach trafficability for heavy equipment, matting required, length of surf zone (equalling the amount of causeway required), normal sea state, depth of water offshore vis-a-vis available anchorages and location of holding ground, etc., must be accommodated. These issues will have to be planned for and will translate to requirements for systems and equipment (of all types) and personnel that will have to be transported to the area to support operations.

Timeliness is another condition that must be accommodated. Port accessibility data herein indicates a problematic relationship with port entry for those ships that are supposed to be the first on scene -- the MPS, APS, and FSS. An MPS squadron carries indigenous equipment to enable off-load (8-10 LCM8, 4-5 SLWT, 15-16 CSP, and 24-25 CSNP)[8] but when one considers that it takes 6 CSNP to create one Roll-on/Roll-off discharge facility

(RRDF) for in-stream ship discharge operations and two powered platforms to tend it that means that there are, for example, not enough CSNP in the squadron to permit simultaneous off-load of all squadron ships. Further, it is to little useful purpose to send the FSS to the crisis location at 30 knots if once it gets there it has no capability to discharge its cargo, or must wait in line loaded until ships such as the MPS have completed their work (if the MPS is called to the crisis) and then use their off-load systems. The point is that loading the FSS with heavy combat equipment may seem the operationally desired thing to do, but the situation may require that some of the space, or a majority of it, be allocated for the less glamorous but equally critical requirement of generating the capability to get combat equipment ashore. This will be a mandatory consideration if the FSS is to be used in support of an east African operation.

Equipment availability or capability is not necessarily an impediment depending on the scope of the operation. The services have a broad range of systems and equipment available to support the LOTS effort, but in some cases the numbers of systems are limited. For example there is currently only one elevated causeway system (ELCAS) in existence.[9] Table 5 discusses the major sea-side LOTS related systems.[10]

The results of JLOTS II in 1984 and 1985, a major demonstration of LOTS systems, showed despite some significant issues (e.g., inability to transport Army Delong piers to the operation area other than by open ocean towing[11] and the lack of a load-out plan for a full ELCAS[12]) that the basic ability exists to perform LOTS functions. On-load and at sea off-load of the principle components of an ELCAS by a C-8 class LASH vessel was demonstrated.[13] In stream Roll-on/Roll-off (RORO) operations were demonstrated.[14] In stream discharge capability for break-bulk and container operations, including TACS off-load of other vessels, was demonstrated.[15] A full range of supporting beach preparation, cargo landing, and throughput systems was demonstrated.[16] The ability to carry large support equipment, including an assembled army temporary container discharge facility (TCDF) (1925Klbs x 60' x 150' x 30'11" (including onboard carried crane equipment)), two tug boats (100' and 60'), and several other craft including a LACV-30, LARC-LX, LCU 1446, and LCU 1667 with various embarked equipment on a Sea Bee class ship was demonstrated.[17]

Given the capability to execute LOTS operations, the principle issues from a theater logistics perspective become priority of movement of LOTS systems into the theater and availability of enough of the right equipment in the theater to do what needs to be done. The priority of movement issue has already been covered to some degree. The final word thereon in this discussion is that the likelihood for a LOTS requirement in contingency support is better than 50 percent if the fastest and most ready ships are to be used. Therefore significant and early consideration must be given to which ships will be called out for use (pages 8-11 and Table 4) and what LOTS equipment they will carry.

The next issue, availability of the right equipment, is related to the first. The nature of the contingency will drive required theater combat force levels which in turn will determine combat equipment and material requirements and associated rates of consumption. These considerations will drive surge and sustainment throughput requirements. Priority of movement will determine LOTS system closure time to the crisis area, and types and quantities of LOTS systems employed will be critical factors in the rate of build up and sustainability of combat power ashore. For example a low intensity crisis, with small numbers of troops may necessitate only a level of effort that can be accommodated with one (or no) ELCAS, one TACS, a RRDF, some number of SLWT, CSP, and CNSP, and beach support equipment. A higher intensity crisis could require two or more ELCAS (except there is only one in the inventory -- Delong piers are the next choice), multiple RRDFs, two or more TACS, and commensurate increases in the numbers of other support systems. Beach gradient and surf zone considerations may dictate longer or shorter ELCAS construction, which will drive how many roadway sections must be lifted. Discharging LASH and Sea Bee lighters at the beach requires an ELCAS because their lighters cannot be beached due to lighter configuration.[18] Transport of these systems to the theater must be planned for and time phased to optimize their impact on the overall effort.

The foregoing all translates to the need for rapid initial sealift of LOTS systems to the theater of operations. Having made this case for early initial lift, other means of lift should be examined to determine whether they would be more effective or efficient in meeting theater logistics requirements. There are three alternatives. These alternatives are routine precedence sealift, airlift, and prepositioning.

Routine precedence sealift is not acceptable if LOTS operations are necessary to sustain the theater. If LOTS systems are delayed in arrival, all surge and sustainment supplies transported by sea will be delayed in landing until the routinely dispatched LOTS systems arrive and are deployed. Critical material in theater, unable to be off-loaded is (from a consumer's standpoint) equally as unuseful as material not there at all. Additionally, assuming there is on-going conflict, supplies in theater embarked in shipping awaiting LOTS off-load are unnecessarily exposed to enemy deep offensive activity, increasing the possibility of damage to ships and their cargoes and potentially loss of both at sea.

Airlift of some LOTS systems is possible but may be impractical for several reasons. The first reason is that LOTS systems are large and would seriously deplete outsized and oversized air lift capacity in order to get the required material in theater. Further, some of the material (e.g., the Army's TCDF) cannot fit in an aircraft of any size. The second reason, closely related to the first, is that if airlift is used to deliver LOTS systems, movement of some other critical air transport criteria material must be delayed. The third, and perhaps most common sense, reason is that LOTS equipment does not have to arrive in theater with such compelling urgency; it just has to arrive there first amongst the equipment and material being lifted by sea. The ideal situation would be to load LOTS systems in the first departing sealift echelon and have it arrive in theater and be set up and operating as the next echelon of shipping arrived.

There are two prepositioning options, afloat or ashore. The afloat option provides excellent flexibility, and to some degree has already been implemented (e.g., LOTS systems embarked in MPS squadrons). Afloat prepositioning of an entire LOTS "harbor" -- ELCAS, RRDF, Off-Shore Petroleum Discharge System (OPDS), Inland Petroleum Discharge System (IPDS), tugs, suitable numbers of SLWTS/CSPS/CNSPS, and the other wide range of beach support equipment -- provides an attractive way to meet the ideal situation discussed in the preceding paragraph. To achieve that goal, of course, a costs versus benefits analysis would have to be conducted based on assessment of its desirability by all geographic commanders and then that priority merged with all others in the budget process. That analysis exceeds significantly the scope of this review.[19]

The ashore prepositioning option is of little value unless LOTS systems happen to be located in the vicinity of the contingency they must support. If they are, then they can be moved to the employment site relatively easily and deployed using overland and small afloat assets. If they are not then the same competition for sealift assets develops as was originally discussed vis-a-vis routine precedence sealift. The viability of this option depends entirely on how lucky one is in guessing where a contingency will occur.

The net result is that at the present time the afloat prepositioning option does not in the main exist, and based on priority in a shrinking military budget it may never exist. That leaves the theater commander with assignment of LOTS systems to the initial sealift echelon as the only presently practical and acceptable option for priority lift of LOTS systems.

Once priority, type, and quantity decisions have been made and the systems have arrived in theater they must be readied for use. This can seem an agonizingly slow process if critical material is waiting to be moved ashore. During JLOTS II it took seven days to erect the ELCAS, exclusive of transportation and other disruptive factors -- depending on the weather such operations could take even longer.[20]

All LOTS off-load evolutions are sea state limited, with most systems designed to operate satisfactorily at a maximum of sea state 3 (5 foot seas at the high end).[21] During JLOTS II practical application and consideration of personnel safety normally resulted in suspension of operations at the high end of sea state 2 (3 foot seas.)[22] Wind speed, state of tide, and tidal current also had an impact on the rate of transfer operations.[23] Additionally, for each discrete discharge evolution lighterage must make a landing on the loaded vessel, depart the loaded vessel, transit to the off-load site, make a landing on the off-load site, depart the off-load site, and repeat the process. As the weather deteriorates each of these evolutions requires more time, becomes more difficult, becomes more dangerous. Not only movement of lighterage is effected, but systems such as the RRDF can develop unacceptable relative motion with the ship it is supporting, ships alongside can work unacceptably due to hull, superstructure, and rigging construction, and safe ship alongside mooring operations can be precluded. The inevitable back-loading of material will require use of the same systems required for off-load of the next incoming ship. All of these conditions equate to manpower, equipment, and time and combine to make LOTS material movement slower than that of similar operations at an improved port. They may combine to frustrate entirely movement of material ashore. Decreased ratios of material throughput, total replenishment stoppage due to weather, and even system damage or destruction due to wind and sea must be incorporated into the plan -- beyond disruptions which may result from enemy deep offensive action.

Finally, with respect to the LOTS operations, the theater planner must determine command relationships. MSC ships and embarked systems will arrive under naval operational control. The beach head, if part of an ongoing amphibious operation will also be under naval control. However, if there is a requirement to support joint forces army troops and systems will be involved and if the operation becomes a stable, long term evolution transition to army control is probable. Attachment and detachment of various service units, arrival and departure of their equipment and systems, interoperability of communications systems (between the services, the control unit and various support activities, and the merchant ships being serviced), and the practical effects of a change in operational control from naval to land forces must be accommodated.

CONCLUSION

Initial and continuing logistic support is a key factor in the ability to exercise combat power. Sea transport and the ability to move combat material ashore in the theater of operations are primary determinants in the success or failure of logistic support. These elements combine to extend operational reach if used effectively. If used ineffectively or inefficiently they can be disruptive and contribute to (or even cause) mission failure.

The data in this review shows that port accessibility and LOTS are two areas that will require careful planning consideration if logistics operations are to be supportive rather than detrimental to overall combat effectiveness. Port accessibility is limited both in areas of access and in access by specific ship class for contingency operations involving force projection in both sub-Saharan Africa and Southwest Asia. The data also shows that careful planning is required with respect to the area of the contingency vis-a-vis specific shipping activated for use. Further, despite the best planning there are, as indicated, some places where port access is simply denied or impractical, necessitating LOTS operations to support both initial and sustainment logistics efforts.

LOTS systems exist that permit the broad range of product delivery from bulk POL, to tanks and helos, to break bulk spare parts. The theater commander must identify port accessibility and then prioritize lift requirements, including LOTS systems, to ensure material can be put ashore as it is needed in the quantities that are needed. In contingencies requiring the use of LOTS systems the theater commander's plans must accommodate a later initial sea supplied peak surge capability, which is related to the load out, transport, and placement/assembly of LOTS systems on arrival. He must also plan on a generally slower throughput capacity and the potential for total system disruption due to natural forces (as well as deep enemy offense action). It is conceivable that the logistics throughput constraint may not be numbers of hulls available to transport needed material, but systems available to move the material ashore once it has arrived in theater if adequate LOTS planning has not been completed.

The net result of the accessibility/LOTS interaction is that an additional level of effort and prioritization is required to develop logistics plans to support forces in a contingency. An additional step is also required in the determination of plan feasibility and acceptability. This paper discusses what the author sees as the related primary issues that must be addressed early on.

This review covers a broad geographic area discussing various capabilities in a general way. As previously stated, accessibility does not for purposes of this review necessarily equate to a high rate of throughout in any given port. This review provides a jumping off point for finite planning since in the final analysis accessibility and throughput must be predicated on:

- A review of actual area small scale charts to account for the latest information at the time

- Can be controlled to a degree by the level of ship loading (trading tons of cargo carried for decreased draft and increased port access)

- The degree of risk the theater commander is willing to accept in damaging and/or grounding vessels attempting marginal port entry conditions

- The availability and condition of port facilities and/or the LOTS assets committed.

This review does not attempt to discuss tons, gallons, or containers landed per day. Each contingency will be different, and potential for each of those quantities will vary depending on the systems selected, which will inevitably be driven by the forces employed.

This review provides an assessment of the order of magnitude of the seaborne logistics support problem for the theater commander, and gives some guideposts for the planning process if faced with a contingency in either sub-Saharan Africa or Southwest Asia. It is, as always, up to the commander and his planning staff to fill in the details as specific contingencies emerge and to shape the battlefield, including the logistics piece of it, to achieve mission success.

TABLE 1

APS, MPS, and RRF ASSOCIATED SHIPS BY TYPE AND CLASS

APS

LASH SHIPS	
C8-S-81b -	SS American Kestrel
	SS Austral Rainbow
C9-S-81d -	SS Green Island
	SS Green Harbor
FREIGHTERS	
C4-S-69b -	SS Santa Victoria
C5 (Nominal) -	MV Advantage
HOSPITAL CARRIER	
C5 (Nominal) -	SS Noble Star
TANLERS	
Overseas -	SS Overseas Alice
Sealift -	USNS Sealift Pacific
FLOAT ON, FLOAT OFF SHIP	
Cormorant -	MV American Cormorant

MPS

ROLL ON, ROLL OFF SHIPS	
Hague -	MS Cpl. Lewis J. Hague, Jr.
	MS Pfc. William B. Baugh
	MS Pfc. James Anderson, Jr.
	MS 1st Lt. Alex Bonnyman
	MS Pvt. Harry Fisher
Kocak -	SS Sgt. Matej Kocak
	SS Pfc. Eugene A. Obregon
	SS Maj. Stephen W. Pless
Bobo -	MS 2nd Lt. John P. Bobo
	MS Pfc. DeWayne T. Williams
	MS 1st Lt. Jack Lummus
	MS 1st Lt. Baldomero Lopez
	MS Sgt. William R. Button
AVIATION LOGISTICS SUPPORT SHIPS	
Seabridge -	USNS Wright
	USNS Curtiss

FAST SEALIFT SUPPORT SHIPS

SL-7 -	USNS Algol
	USNS Bellatrix
	USNS Denebola
	USNS Pollux
	USNS Altair
	USNS Regulus
	USNS Capella
	USNS Antares

READY RESERVE FORCE

AUXILIARY CRANE SHIPS

C6-S-1qd -	SS Keystone State
	SS Gem State
	SS Grand Canyon State
C5-S-73b -	SS Gopher State
	SS Fickertail State
	SS Cornhusker State
C5-S-1qc -	SS Diamond State
	SS Equality State
	SS American Banker
C6-S-60b -	SS Green Mountain State
	SS Beaver State

TROOP SHIPS

S5-S-MA49C -	SS Patriot State
Barrett -	SS Empire State

OIL TANKERS

Sealift -	SS American Explorer
Maumee -	SS Shoshone
Falcon -	MV Mission Capistrano
Overseas -	SS Mission Buenaventura
Unidentified -	SS American Osprey
Potomoc -	SS Potomoc
	SS Mount Vernon
	SS Mount Washington

GASOLINE TANKERS

Alatna -	MS Alatna
	MS Chattahoochee
Tonti-	MS Nodaway

ROLL ON/ROLL OFF SHIPS

Barber Line -	MV Cape Henry
	MV Cape Horn
	MV Cape Hudson
C7-S-95a -	SS Cape Inscription
	SS Cape Isabel
	SS Jupiter

Barber Line -	MC Cape Decision
	MV Cape Domingo
	MV Cape Douglas
	MV Cape Ducato
	MC Cape Diamond
Great Lakes -	MV Cape Lambert
	MV Cape Lobos
Unidentified -	MV Cape Edmont
Callaghan -	GTS Adm. William W. Callaghan
Meteor -	SS Meteor
C3-ST-14A -	SS Comet

CARGO BARGE CARRIERS

Sea Bee -	SS Cape May
	SS Cape Mendocino
	SS Cape Mohican

LASH SHIPS

C9-S-81d -	SS Cape Farewell
	SS Cape Flattery
C8-S-81d -	SS Austral Lightning
	SS Cape Florida

GENERAL CARGO SEATRAIN SHIPS

Seatrain -	SS Maine
	SS Washington

GENERAL CARGO BREAK BULK SHIPS

C5-78 -	SS Cape Nome
C5-S-75A -	SS Cape Gibson
	SS Cape Girardeau
C4-S-1u -	SS Cape Johnson
	SS Cape Juby
C3-S-76a -	SS Del Monte
	SS Del Viento
	SS Del Valle
C4-S-66a -	SS Cape Blanco
	SS Cape Bon
	SS Cape Borda
	SS Cape Bover
	SS Cape Breton
C3-S-37d -	SS Gulf Banker
	SS Gulf Farmer
	SS Gulf Merchant
	SS Gulf Shipper
	SS Gulf Trader
C4-S-58a -	SS Cape Ann
	SS Cape Alexander
	SS Cape Archway
	SS Cape Alva
	SS Cape Avinof
C3-S-37c -	SS Cape Canaveral

	SS Cape Canso
	SS Cape Carthage
	SS Cape Catoche
	SS Cape Chalmers
	SS Cape Charles
	SS Cape Clear
	SS Cape Cod
C4-S-57a -	SS Pioneer Commander
	SS Pioneer Contractor
	SS Pioneer Crusader
C4-S-1u -	SS Santa Ana
	SS California
C3-S-46a -	SS Banner
	SS Buyer
	SS Courier
C3-S-33a -	SS Cape Catawba
	SS Lake
	SS Northern Light
	SS Pride
	SS Scan
	SS Southern Cross
C3-S-38a -	SS Adventurer
	SS Agent
	SS Aide
	SS Ambassador

Table 2

SHIP CLASS DATA

Category	Ship Class	Length[1]	Draft	Prop[2]	S/S[3]	Tugs
APS						
LASH	C8-S-81b	249.94	12.43	1	Y	2
	C9-S-81d	272.29	12.44	1	Y	2
FREIGHTER	C4-S-69b	176.5	9.1	1	Y	1
	C-5(nominal)	171.0	11.5	1	Y	1
HOSPITAL	C-5(nominal)	171.3	9.7	1	Y	2
TANKER	Overseas	201.23	11.79	1	Y	2
	Sealift	178.92	10.5	1+BT[4]	Y	1
FLOAT ON/OFF	Cormorant	225.06	10.49 19.81[5]	1+2T[6]	Y	2
MPS						
ROLL ON/ ROLL OFF	Hague	230.25	9.78	1	Y	2
	Kocak	250.24	9.82	1	Y	2
	Bobo	205.18	8.99	1+BT	Y	2
AVIATION LOG	Seabridge	183.49	10.36	1	Y	1
FSS	SL-7	288.38	11.18	2	Y	2
RRF						
AUX CRANE	C6-S-1qd	203.82	10.06	1	Y	1
	C5-S-73b	185.93	9.14	1	Y	1
	C6-S-1qc	203.61	10.16	1	Y	1
	C6-S-60b	202.98	9.63	1	Y	1

Category	Ship Class	Length	Draft	Prop	S/S	Tugs
TROOP SHIP	S5-S-MA49C	166.12	8.87	2	Y	1
	Barrett	162.5	8.2	1	Y	1
OIL TANKERS	Sealift	187.5	9.8	1	Y	2
	Maumee	189.0	9.8	1	Y	2
	Falcon	204.93	11.04	1	Y	2
	Overseas	201.23	11.67	1	Y	2
	Unident[7]	201.5	11.0	1	Y	1
	Potomac	189.0	10.4	1	Y	2
GASOLINE TANKERS	Alatna	92.0	7.0	2	Y	0
	Tonti	99.1	5.9	1	Y	1
ROLL ON/ ROLL OFF	Barber Line	228.5	10.8	1	Y	2
	C7-S-95a	208.71	9.78	2	Y	1
	Barber Line	207.4	9.59	1+2T[6]	Y	1
	Great Lakes	207.88	9.3	2	Y	2
	Unident[7]	199.0	9.4	1	Y	1
	Callaghan	211.61	8.86	2	Y	1
	Meteor	164.7	8.8	2	Y	1
	C3-ST-14A	152.1	8.9	2	Y	1
CARGO BARGE CARRIER	SeaBee	266.89	11.93	1	Y	2

Category	Ship Class	Length	Draft	Prop	S/S	Tugs
LASH	C9-S-81d	272.3	12.44	1	Y	2
	C8-S-81d	249.94	10.7	1	Y	2
GENERAL CARGO	Seatrain	249.99	8.22	1	Y	1
	C5-78	183.33	10.39	1	Y	1
	C5-S-75a	184.41	10.68	1	Y	1
	C4-S-1u	172.22	9.63	1	Y	1
	C3-S-76a	159.1	9.4	1	Y	1
	C4-S-66a	164.59	9.96	1	Y	1
	C3-S-37d	150.78	9.17	1	Y	1
	C4-S-58a	174.35	9.4	1	Y	1
	C3-S-37c	150.8	9.75	1	Y	1
	C4-S-57a	171.0	9.8	1	Y	1
	C4-S-1u	172.2	9.8	1	Y	1
	C3-S-46a	150.26	9.32	1	Y	1
	C3-S-33a	148.15	8.68	1	Y	1
	C3-S-38a	150.27	8.53	1	Y	1

NOTES
1) Length and draft in meters
2) Number of propellers
3) Self-sufficient: yes/no
4) BT - Bow thruster
5) Draft when ballasted down to off-load
6) 2T - Thrusters at bow and stern
7) Unident - No classname or type identified

Table 3

Port Limitation Summary[1]

1. Senegal
   Dakar: port limiting draft 10m August - October
   port limiting draft 12m November - July

   Ports inaccessible: St. Louis
   Rufisque
   Karabane

2. Gambia
   Banjul: port limiting draft 8.5m

3. Guinea-Bissau
   Ports inaccessible: Cacheo
   Bissau
   Bolama

4. Guinea
   Kamsar: port limiting length 229m
   Conakry: port limiting draft 8.5m
   Ports inaccessible: Victoria
   Dubreka
   Benty

5. Sierra Leone
   Freetown: berthing draft limitation 10m
   Ports inaccessible: Pepel
   Bonthe

6. Liberia
   Monrovia: no limitations
   Buchanan: no limitations
   Ports inaccessible: Robertsport
   Greenville
   Cape Palmas

7. Ivory Coast
   San Pedro: port limiting length 220m
   berthing draft limitation 10m
   one tug only

   Abidjan: port limiting draft 11.28m
   Ports inaccessible: Sassandra
   Grand Lahou
   Jacqueville
   Grand Bassam

Note: 1) inaccessible includes open roadstead or anchorage only ports with no shore berthing facilities

8. Ghana

Takoradi: berthing length limitation 183m
berthing draft limitation 8.8m

Tema: berthing length limitation 244m
berthing draft limitation 9.6m

Ports Inaccessible: Axim
Sekondi
Elmina
Cape Coast
Salt Pond
Accra

9. Togo

Lome: port limiting length 270m

Kempe: berthing draft limitation 9.5m
maximum allowable displacement 44,000 tons

10. Benin

Contonou: port limiting length 210m
port limiting draft 10m
tanker berthing length limitation 200m
tanker berthing draft limitation 9.75m

11. Nigeria

Lagos: port limiting length 183m
port limiting draft 9.2m

Ports inaccessible: Koka
Sapele
Burutu
Warri
Akassa
Brass
Orika
Port Harcourt
Opobo
Calabar

12. Cameroon

Ports inaccessible: Limbe
Tiko
Douala
Kribi

13. Equatorial Guineau

Bata: no pilot or tugs although limiting draft accomodates majority of shipping (12m)

14. Gabon

Owendo: berthing length limitation 220m
berthing draft limitation 9m

Port Gentil: berthing draft limitation 10.5m
one tug only

Cap Lopez: no limitations, sufficient depth for float on/float off operations to full submergence depth
Ports inaccessible: Libreville

15. Congo
Pointe Noire: port limiting draft 10.4m
tanker berthing length limitation 220m
tanker berthing draft limitation 10.2m
Ports inaccessible: Loango

16. Cabinda (Angola)
Ports inaccessible: Landana
Cabinda

17. Zaire
Ports inaccessible: Banana
Boma
Matadi
(Congo river depth limitation)

18. Angola
Luanda: berthing draft limitation 12m
Lobito: port limiting draft 10.3m
Namibe: no limitations
Ports inaccessible: Ambriz
Porto Amboim
Novo Redondo
Benguela
Tombua

19. Namibia
Walvis Bay: port limiting draft 10m
one tug only
Ports inaccessible: Luderitz

20. South Africa
Saldanha Bay: no limitations, sufficient depth for float on/float off operations to full submergence depth
Cape Town: no limitations
Simonstown: no limitations
Port Elizabeth: port limiting length 252m
port limiting draft 11.6m
tanker berthing length limitation 242m
tanker berthing draft limitation 9.8m
East London: port limiting length 239m
port limiting draft 9.9m
tanker berthing length limitation 204m
tanker berthing draft limitation 9.9m
Durban: Port limiting length 244m
Cargo berthing draft limitation 12.2m
Tanker berthing draft limitation 11.5m

Richards Bay: no limitations
Ports inaccessible: Port Nollath
Lambert's Bay
Mossel Bay

21. Mozambique
Maputo: port limiting depth 10.5m
cargo berthing length limitation 250m
tanker berthing length limitation 229m
tanker berthing draft limitation 11.25m
Nacala: cargo berthing draft limitation 9.75m
tanker berthing draft limitation 9.4m
one tug only
Port Amelia: berthing draft limitation 8.8m
Ports inaccessible: Inhambane
Beira
Vila do Chinde
Porto de Quelimane
Porto Belo
Porto de Pebane
Rio Moebase
Porte de Moma
Porto de Angoche
Mocambique
Ibo

22. Tanzania
Mtwara: berthing length limitation 175m
berthing draft limitation 9.75m
Tanga: berthing length limitation 200m
berthing draft limitation 10m
Ports inaccessible: Mikindani
Lindi
Kilwa Kivinje
Dar es Salaam
Chake Chake
Wete

23. Kenya
Mombasa: port limiting length 259m
Ports inaccessible: Kilifi Creek
Lamu

24. Somalia
Kismaayo: berthing draft limitation 8.5m
Muqdisho: berthing length limitation 200m
berthing draft limitation 12m
Ports inaccessible: Baraawe
Merca
Barbera: Cargo berthing draft limitation 9.8m
Tanker berthing length limitation 164.6m
Tanker berthing depth limitation 8.54m

25. Djubouti
   Djibouti: port limiting depth 11m

26. Ethiopia
   Aseb: port limiting depth 10.3m
   Tanker off-shore berth limiting length 195m
   Tanker off-shore berth limiting draft 11.3m
   Mitsiwa: port limiting length 180m
   port limiting depth 9.14m

27. Sudan
   Port Sudan: port limiting depth 11.3m

28. Egypt
   Port Suez: berthing draft limitation 8.5m
   Port Safaga: no tugs available although depth accomodates vessels with draft up to 10.36m
   Ras Gharib: no tugs available although depth at oil terminal can accomodate all classes
   Abu Zeniman: no tugs or pilots and berthing draft limitation (7.62m) excludes all vessels except the two classes of gasoline tanker
   Ports inaccessible: Al Qusayr
   Adabiya

29. Israel
   Elat: no limitations

30. Jordan
   Al Aqabah: no limitations

31. Saudi Arabia (Red Sea)
   Yanbu/King Faud: no limitations
   Al Qadimah: no limitations
   Jiddah: no limitations
   Gizan: port limiting depth 10m

32. Yemen
   As Salif: berthing length limitation 180m
   Ahmedi: port limiting depth 10m
   Al Mukha: port limiting depth 9m
   Aden: berthing length limitation 229m
   Al Mukalla: berthing depth limitation 9.1m
   one tug only
   Inaccessible ports: Nishtun

33. Oman
   Mina Raysut: port limiting depth 10m
   Mina Qabus: no limitations
   Inaccessible ports: Mina Al Fahl

34. United Arab Emirates (UAE)

Fujeirah:	no limitations
Kohr Al Fakkan:	no limitations
Mina Saqr:	port limiting length 244m port limiting depth 11.5m
Ash Shariqah:	port limiting depth 10.5m
Umm Al Qaywayn:	no tugs or pilots available although can accomodate vessels up to 210m in length and 9.8m in draft
Al Hamriyah:	berth limiting length 230m. Port function is liquified petroleum gas terminal. Berthing configuration and design severly limit usefulness for military purposes given availability of other local ports although access, mooring, and off-loading possible.
Dubayy:	no limitations
Mina Jabal Ali:	no limitations
Abu Dhabi:	no limitations
Umm An Nar:	berthing length limitation 169.8m berthing draft limitation 9.2m
Az Zannah Ruways:	no limitations

35. Qatar

Musayid:	port limiting depth 11.3m
Ad Dawhah:	port limiting length 189m port limiting depth 8.7m

36. Bahrain

Sitrah:	no limitations
Mina Sulman:	berthing draft limitation 11.5m, all tankers work at Sitrah

Ports inaccessible: Al Manamah

37. Saudi Arabia (Persian Gulf)

Ad Dammam:	no limitations
Ras At Tannurah:	no limitations (tanker terminal with pierside berthing)
Jubail:	no limitations
Ras Al Mishab:	port limiting depth 10m

38. Kuwait

Shuaiba:	no limitations
Mina Al Ahmadi:	no limitations
Al Kuwayt:	port limiting depth 8.5m

39. Iraq

Umm Qasr:	berthing draft limitation 9.75m
Al Faw:	port limiting depth 10.6m berthing length limitation 205.75m
Al Baker:	no limitation (principle purpose oil loading)

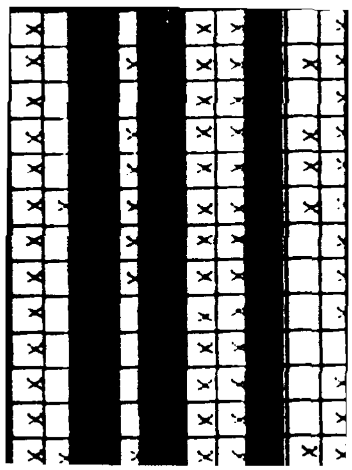
Khawr Al Amaya:	no limitations (principle purpose oil loading)
Al Basrah:	port limiting depth 8.8m berthing length limitation 182m

40. Iran

Khorranshahr:	port limiting depth 8.53m berthing length limitation 175m
Abadan:	berthing length limitation 187m berthing depth limitation 9.8m
Khosrowabad:	berthing length limitation 152m
Bandar E Mah Shahr:	port depth limitation 12m cargo berthing length limitation 268m tanker berthing length limitation 237.7m tanker berthing depth limitation 11.73m
Bandar Khomeyni:	no limitations, however no tanker facilities for bulk oil transfer
Jazireh Ye Khark:	no limitations (oil loading facility)
Bushehr:	port limiting depth 8.5m port limiting length 170m
Bandar Shahid Rejaie:	no limitations
Bandar Abbas:	port limiting depth 9m
Chah Bahar:	port limiting length 200m port limiting draft 9.4m

41. Pakistan

Karachi Harbor:	port limiting depth 9.7m cargo berthing length limitation 213.3m
Port Muhammad Bin Qasm:	port limiting length 272.5m port limiting depth 12.4m no facilities for bulk oil transfer



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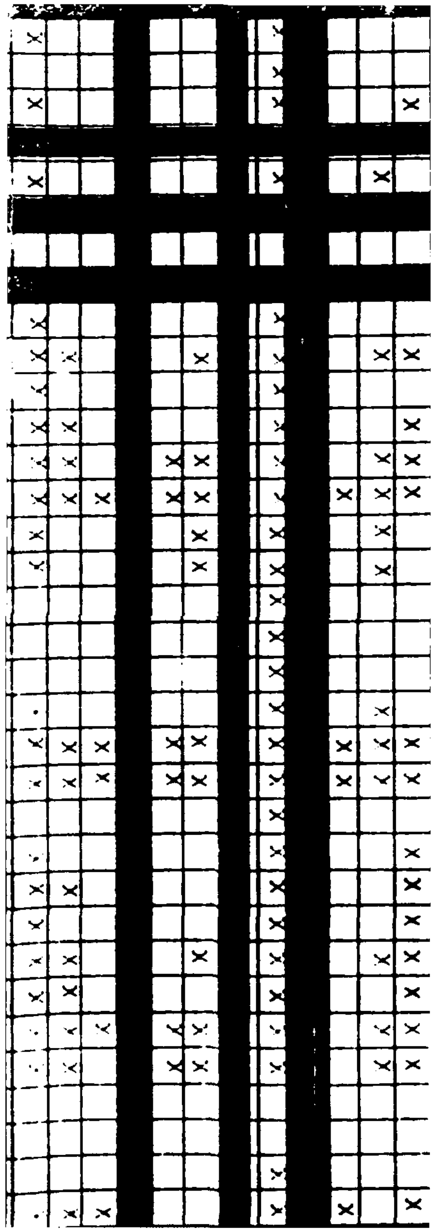

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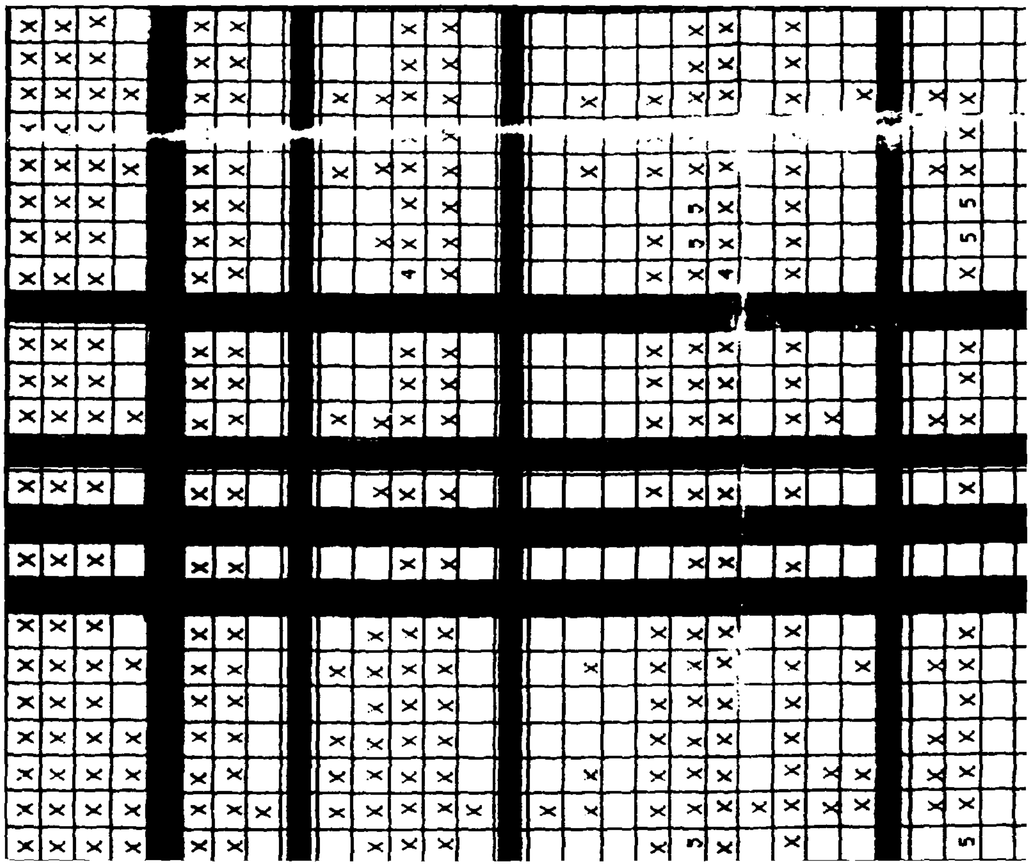

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NOTES:

1. [illegible] PORT ACCESSIBLE TO CLASS
2. AUGUST–OCTOBER
3. NOVEMBER–JULY
4. WATER DEPTH SUITABLE FOR FLOAT ON/OFF SUBMERGENCE
5. PORT SUITABLE FOR ENTRY BUT NO [illegible] FACILITIES

TABLE 5
LOGISTICS OVER-THE-SHORE SYSTEMS

1. ELEVATED CAUSEWAY MODULAR (ELCAS (M))

The Elevated Causeway, Modular (ELCAS (M)) is a modular pier facility, composed of container compatible modules, providing an interface between displacement craft carrying cargo and the beach. The ELCAS (M) will have a nominal length of up to 3,000', as required, to reach a 20' water depth at the pierhead and is 15' above the mean low water level. The pierhead will be 72' wide by 240' long. The two long sides of the pierhead will have a fendering system to accommodate unscathed lighter interface. The ELCAS (M) is constructed by erecting initial section(s) and mounting a construction crane on top of them. Subsequent sections will be cantilevered from the previously erected sections and secured in place with piles. An ELCAS (M) roadway section measures 24' by 40', consisting of three ISO pontoons, each measuring 40'x8'x4.5'. Emplaced on the ELCAS (M) pierhead are two vehicle turntables for truck turnarounds which are supported by air bearings. Two container-handling cranes will be stationed on the ELCAS (M) pierhead to transfer cargo from lighters to container handling vehicles for subsequent transport to shore. The constructed ELCAS (M) will be equipped with a lighting system. Side-Loadable Warping Tugs and Modular Causeways will be used to install, maintain, and retrieve the ELCAS (M) system.

2. ROLL-ON/ROLL-OFF DISCHARGE FACILITY (RO/RO DF)

The Roll-On/Roll-Off discharge Facility (RO/RO DF) consists of a RO/RO platform, a "B" or Sea End section with provisions for "Rhino" horn, a Calm Water Ramp (CWR), a fendering system, a lighting system, and an emergency anchor system. The RO/RO DF provides an interface between RO/RO ships and displacement type lighterage. It will support self-sustaining and non-self-sustaining RO/RO ships. The Platform is approximately 65' wide by 180'long. The "B" or Sea End provides an interface between the RO/RO platform and displacement craft. The CWR is used with non-self-sustaining ships. The lighting system is used during night operations and includes integral power generation and distribution. The fendering system is used to maintain position alongside a deep draft vessel being serviced and for fendering of shallow draft vessels being serviced. The emergency anchor system is used during adverse weather conditions or when the ship being serviced is required to depart due to adverse enemy action or weather conditions. The RO/RO DF is tendered by two Side Loadable Warping Tugs (SLWTs). The SLWT has a deck-mounted "A" frame and winch for hoisting/lifting and assembly of the RO/RO DF hardware and components. The SLWT also has a stern anchor.

3. OFFSHORE POL DISCHARGE SYSTEM

The Offshore POL Discharge System supports the fuel requirements of Army, Air Force, and Marine Corps units operating ashore. The system consists of 4 miles of flexible steel, reinforced "float/sink" piping, a temporary spread moor for a tanker, and a single point moor called a SALM (Single Anchor Leg Moor). The tanker sets a spread moor and deploys the pipe to the shore with the assistance of four SLWTs or other equivalent water craft. Within 48 hours the tanker is ready to pump POL to the beach at the rate of 1.2 million gallons per 20-hour day. Within 7 days the 900 ton SALM is installed, with the assistance of four SLWTs, and it provides uninterrupted POL delivery. The SALM permits a tanker to remain on station, and pumping, in much higher sea states than is possible on the spread moor. The SALM is recoverable and can be towed or lifted to a new location and reinstalled.

4. ASSAULT FOLLOW-ON ECHELON (AFOE) MOORINGS

The AFOE mooring system permits the close fore-and-aft mooring of ships discharging at an amphibious objective area. It is comprised of standard 10' mooring buoys, each positioned by four 15-ton anchors. Fore-and-aft moorings increase the number of ships that can be moored together.

The mooring system is positioned by SLWTs. TACS or other self-sustaining ships are moored with the aid of causeways sections self-propelled (CSPs) and SLWTs. The system permits cargo operations in-the-stream up to sea state 3, the operational limit of lighterage. However, the moorings can safely accommodate ships in 35-knot winds and in sea state 5.

Installation and retrieval of the AFOE moorings are the responsibility of amphibious construction battalions. Installation of each set of moorings requires 2 days with about 10 personnel per shift, including the SLWT crews.

5. FLOATING CAUSEWAY (FC)

The Floating Causeway (FC) consists of non-powered intermediate, offshore and beach end sections, and an Anchor Mooring system (AMS). It extends from the high water line out into the surf zone to a mean low water depth of 8'. The maximum working length of an FC is approximately 1,500'. The beach end sections include transition ramps from the roadway surface to the beach. The offshore end incorporates an adapter end for the discharge of cargo from displacement lighters onto the roadway. The offshore end uses the "Rhino" horn to mate with lighters so equipped. The FC uses an AMS to retain an emplaced FC. The AMS uses large marine anchors placed perpendicular to the roadway, offshore, and dry beach anchors to secure the FC to the beach. Two SLWTs are associated support items. The SLWTs are used to insert, retract, and tender the FC and to emplace and remove the larger AMS anchors. The FC is used as a dry bridge in the transfer of cargo (primarily rolling cargo) from displacement lighters to the shoreside logistics operation.

6. PONTOON CAUSEWAY SYSTEM

The Pontoon causeway system was developed during the Second World War. The system uses as a standard building block the P-1 "can", a 7'L by 5'W by 5'H steel box (and variants) in a fifteen-long by three wide configuration.

The modules are bolted together to form causeway sections. The basic intermediate section causeway has connectors on both ends to allow other causeway sections to be connected on either end to make up a string of causeways.

A variant of the causeway is the "beach end" section which has a ramp over which rolling stock can be driven ashore. The "sea end" has a notched end, which acts as a receptacle for the bow of a Landing Craft Utility (LCU) or a Landing Ship Tank (LST) and holds the ship or craft in position while it discharges its vehicular cargo directely onto the causeway pier.

The addition of side connector "cans" (two on each side of a standard intermediate causeway section) permits causeway sections to be connected either in a side by side or end to end configuration. These make a RO/RO DF.

The addition of spudwell "cans" (two per side) through which steel pilings are inserted, converts the CSNP into a causeway section that can be elevated. A series of causeways connected and elevated form an Elevated Causeway when combined with other ELCAS sub-systems.

7. WATERJET PROPULSION ASSEMBLY

The Waterjet Propulsion Assembly (WPA) is a causeway module containing a diesel engine and waterjet with a 360 degree rotatable nozzle. Two WPAs and a center section (which contains the fuel tank and batteries) replace 12 P-1 modules and make a Causeway Section, Powered (CSP). A CSP, when connected to a series of CSNPs, makes up a causeway ferry to lighter vehicles and supplies ashore.

8. SIDE LOADABLE WARPING TUG (SLWT)

The addition of a winch and A-frame to the CSP results in the configuration known as the SLWT. The SLWT is a working craft, operated by an eight-man crew, used to assemble, install, and tend causeway systems, dry cargo off-loading systems, AFOE moorings, and bulk liquid discharge systems. The SLWT has the capability to perform as a CSP to propel causeway ferries when the A-frame is removed. The term "side loadable" is derived from the design feature which permits it to be side loaded on LSTs and other vessels.

9. CAUSEWAY FERRY (CF)

The Causeway Ferry (CF) consists of a powered section, two non-powered intermediate sections, and a non-powered beach end section joined end-to-end. It has a loaded capacity of 100 short-tons per non-powered section and approximately 50 short-tons for the powered section. It carries a total cargo capacity of 350 short-tons with approximately 12" of freeboard. The powered section is composed of powered modules with internal propulsion and control components connected to non-powered modules. The CF will operate in the J-LOTS environment between RO/RO and lift-on/lift-off ships and shoreside logistics operations. At the shore end the CF is offloaded by ELCAS crane, or it is beached and offloaded by rough terrain fork lifts (RTFL), rough terrain cargo handlers (RTCH), or light amphibious cargo handlers (LACH). Upon arrival in the operational area, the CF components will be offloaded from transport shipping and assembled for use. Each operational system includes pilot-to-operator, operator-to-commercial ships, and operator-to-command and control communication equipment.

10. PONTOON AIR CUSHION KIT (PACK)

The PACK consists of a lightweight peripheral skirt system with autonomous air supply units that can be attached in the field to a modular causeway barge (80'x32') converting it into an air cushion supported platform capable of carrying 140 short-tons of cargo. There are two diesel engine (CM 8V-9LTA) centrifugal fan units which supply pressurized air to the skirt system. The diesel engine/fan units are skid mounted for easy deployment. The skids utilize existing attachment points on the deck of the module pontoons for fastening purposes. The PACK is supplied with "pusher knees" that can be attached to one end of the causeway section to facilitate warping operations with US Army lighters. The PACK (excluding Modular Causeway) is transportable in a 40' ISO container.

The PACK provides enhanced mobility and an amphibious capability to permit operations where the current modular causeway sections are incapable of traversing shallow beach gradients or LOTs sites that have restrictive hydrographic features (i.e., offshore sandbars, coral reefs). There is currently one prototype model in the inventory. It has been demonstrated satisfactorily.[24]

11. CANTILEVERED LIFT FRAME (CF)

The CLF gives LASH vessels the capability to lift and deploy heavy, outsized equipment and to offload offshore during LOTS operations. This special lifting device attaches to the LASH ship's gantry crane (designed to lift 30'x 60' barges up to 500 short-tons) and enables the lift of non-barges and eccentric loads up to 150 tons and approximately 60'wide x 90'long. The frame was designed to be mated to the four lifting sockets of either the Morgan or Alliance lighter crane lifting frames.

12. HIGH SEA STATE CONTAINER TRANSFER SYSTEM

The HISEACOTS is a system that has been developed to stabilize the offloading/lighter interface in high sea states (SS 3/4). The system consists of a floating platform made up of modular ISO pontoons (120' x 56') with fore and aft ramps and batterboards to guide air cushion vehicles (i.e., US army LACV-30) onto the platform. This platform is fitted with a specially designed gantry crane that is used to offload containers/ vehicles. The gantry crane has a pendulation attenuator bar that mitigates pendulation motions through friction forces generated at the bar by the container slings. A positive lock/spar device further reduces any heave motions present and allows the offload of eccentrically loaded containers. The HISEACOTS is designed to offload ISO containers and cargo weighing up to 50,000 pounds in SS 4. There is one prototype system, which was demonstrated in JLOTS III in May 1991.[25]

13. LIGHTER AIR CUSHION VEHICLE, 30 TON (LACV-30)

The LACV-30 is a military adaptation of the Bell Aerospace Company air cushion vehicle Voyageur and is used primarily in Logistics-Over-The-Shore (LOTS) operations. It is used to provide the logistics system with a rapid lift capability of moving cargo and equipment over water, marsh areas, beaches, ice, snow, and land. The LACV-30 provides a method of augmenting congested port facilities or replacing lost or reduced port capabilities. The LACV-30 is also intended to support secondary missions such as coastal, harbor, and inland waterway operations, support of amphibious operations, ship-to-shore operations, transport operations, and search and rescue operations. The LACV-30 can negotiate Sea State 2 and 8' plunging surf.

14. LANDING CRAFT, UTILITY (LCU) 2000

The LCU 2000 is an evolution of landing craft designs, succeeding the 1646 Class LCU and replacing the 1466 Class in the Active Army and Reserve inventories. The mission of the LCU 2000 is to provide transportation of rolling and tracked vehicles, containers, and outsized and general cargo in support of LOTS operations as well as coastal, harbor, and inland waterway missions. The LCU 2000 has an overall length of 174', a beam of 42', and a full load design draft of 8'. It is capable of carrying up to 28 20' or 12 40' ISO freight containers secured on its 2,500 square foot cargo deck, and can carry a full load of 350 short tons. It is configured to deliver 175 short-tons through its 16'wide bow ramp to shallow 1/30 gradient beaches without exceeding a 4' bow draft. The LCU's 2 Cummins V16 turbo-charged diesels with 2,500 HP provides a full load speed of 10 knots and a light delivery speed of 12 knots. The 300 HP Cummins powered bow thruster provides added maneuverability during docking or undocking operations. It is classed by the American Bureau of Shipping (ABS) for full ocean service and one-man engine room operations, and is built to US Coast Guard standards. LCUs are equipped with the latest navigation, communication, and electronic equipment including an automatic pilot and steering system. The LCU 2000 is capable of sustaining its crew of two warrant officers and 11 enlisted personnel for periods of up to 18 days and over 6,000 nautical miles without refueling.

15. LOGISTICS SUPPORT VESSEL (LSV)

The LSV has the capability of intra-theater linehaul of cargo to support unit deployment/relocation and tactical and sustained resupply to remote, undeveloped areas along coastlines and on inland waterways. Additionally, the LSV is capable of self-delivery to a theater of operations. Mission requirements include the capability to assist in discharging and backloading ships in a roll-on/roll-off or LOTS operation (with its drive-through capability) and the capability to transport heavy, outsized cargo. The vessel has a self-delivery range of 6,500 nautical miles at a speed of 11.5 knots and is capable of sustaining a screw of 20 for a minimum of 30 days. Utilizing 10,500 square feet of deck cargo space, the LSV can transport 2,000 short-tons of cargo consisting of rolling stock, general cargo, or ISO containers. Principal characteristics of the LSV are: length (overall), 273'; beam (molded), 60'; beaching draft, 4' at the bow, with 900 tons of cargo distributed uniformly over the deck; twin screw diesel propulsion; 3,900 shaft HP; bow thruster; bow and stern ramps; and deck sockets to secure all types of cargo transported.

16. SEASHED SYSTEM

The SEASHED System consists of a stack of up to three SEASHEDs on a Containership Cargo Stowage Adapter (CCSA).

SEASHEDs are open-topped large cargo containers that fit into the container cells of a containership to provide the capability to carry large, heavy, or outsized cargo such as Army and Marine corps tanks and helicopters. Each SEASHED occupies the space of three 40' containers in width and has the overall height of 1-1/2 containers, having dimensions of 25' wide, 40' long, and 12-1/2' high. The maximum cargo capacity of each SEASHED is 220,000 pounds. Each SEASHED weighs 76,000 pounds. The floor of the SEASHED opens to allow cargo to be lowered through to the SEASHED or CCSA below. The clear opening of the floor is 30' x 18'. The CCSA has two elements - the adapter frame and three pontoon flats - which provide the same storage capability as a SEASHED.

17. FLATRACKS

Heavy duty flatracks provide a capability to use containerships to carry oversize cargo. They are portable, open-topped, open-sided units which fit into existing below-deck container cell guides. When placed side-by-side, a folding ramp may be positioned between the flatracks so that vehicles can cross from one to another. Heavy duty flatracks, have a capacity of 60 tons, roughly equivalent to the weight of an M-1 tank. Strengthening of cell guides and tank tops (ship modifications) is required to use flatracks in weight configurations greater than 30 tons. Each FSS will carry 78 flatracks.

NOTES

1. Data for Table 1 is extracted from applicable parts of Section III of Navy Fact File listed in the bibliography.

2. This paper expands the scope of a project originally undertaken and reported by this author in an unpublished paper on the "Accessibility of Continental Sub-Saharan Africa Ports" as referenced in the bibliography. The explanation of methods of port and accessibility review and underlying assumptions, data in Tables 1 and 2, and data in Tables 3 and 4 regarding Senegal through Somalia (to Muqdisho) are as developed by this author in that report. Since there is no possibility of copyright infringement, and it was my own original thought and work, individual footnotes on relevant discussion and data taken from that report have not been included herein.

3. Ports evaluated and port characteristics have been derived from the applicable sections of the following publications listed in the bibliography:

- Lloyd's Ports of the World 1991
- Pub. 150 World Port Index
- Pub. 123 Sailing Directions (Enroute) for the Southwest Coast of Africa
- Pub. 143 Sailing Directions (Enroute) for the West Coast of Europe and Northwest Africa
- Pub. 171 Sailing Directions (Enroute) for East Africa and the South Indian Ocean
- Pub. 172 Sailing Directions (Enroute) for the Red Sea and the Persian Gulf
- Pub. 173 Sailing Directions for India and the Bay of Bengal

Individual footnoting of each piece of relevant data has not been attempted since sources were in general agreement and because interpolation and author's judgement were sometimes required to decide precisely what the limiting factors for a given port actually were.

4. Shipboard navigational and cargo handling characteristics have been derived from the applicable sections of the following publications listed in the bibliography:

- Combat Fleets of the World 1988/89 Their Ships, Aircraft, and Armament
- Jane's Fighting Ships 1989-90
- Ships and Aircraft of the U.S. Fleet (Fourteenth Edition)
- Strategic Sealift Program Information

5. The Joint Staff, Joint Test Pub 4-0 Doctrine for Logistic Support of Joint Operations (Washington: 1990), pp. I-6 and I-7.

6. The Joint Chiefs of Staff, Joint Pub 4-01.6 Joint Tactics, Techniques, and Procedures for Joint Logistics Over the Shore (Washington: 1991), pp. II-8-18.

7. Ibid., p. II-8.

8. U.S. Navy Department, Office of the Chief of Naval Operations, Strategic Sealift Division (OP-42), Strategic Sealift Program Information (Washington, DC: 1985), p. 34.

9. Telephone conversation with LCDR E. St. Germaine Office of the Chief of Naval Operations (OP-422D), Washington, DC, 1 May 1992.

10. Relevant data from Strategic Sealift Program Information, Part II and 1991 Container System Hardware Status Report, Part IV, as listed in the bibliography, have been extracted and merged to describe each individual system in Table 5.

11. JLOTS II Test Directorate, Analysis and Evaluation Joint Logistics Over-the Shore II JLOTS II Throughput Test (Norfolk, VA: 1985), pp. 5-8 and 5-9.

12. JLOTS II Test Directorate, Joint Logistics Over-the Shore II Test and Evaluation JLOTS II Deployment Test (Norfolk, VA: 1985), p. 124.

13. Ibid., pp. 139-140.

14. JLOTS II Test Directorate, Report of Test Joint Logistics Over-the-shore II JLOTS II Roll On/Roll Off Ship Operations (Norfolk, VA: 1984), pp. 3 and 50-54.

15. JLOTS II Test Directorate, Analysis and Evaluation Joint Logistics Over-the-Shore II JLOTS Throughput Test (Norfolk, VA: 1985) pp. 3-46-3-84, 3-107-3-117, 6-10, and 6-12.

16. Ibid., pp. 3-85-3-106, 3-112-3-117, and 6-11-6-18.

17. JLOTS II Test Directorate, Joint Logistics Over-the-Shore II Test and Evaluation JLOTS II Deployment Test (Norfolk, VA, 1985), pp. 10-11 and 67-68.

18. The Joint Chiefs of Staff, Joint Pub 4-10.6 Joint Tactics, Techniques, and Procedures for Joint Logistics Over-the-Shore (Washington: 1991), pp. VI-4 and VI-16.

19. Discussion 1 May 1992 with the Department of the Army (DALO-TSM) indicates that the Army is currently reviewing the efficacy of prepositioning significant quantities of LOTS material on Afloat Prepositioning Force Ships.

20. JLOTS II Test Directorate, Analysis and Evaluation Joint Logistics Over-the-Shore II JLOTS II Throughput Test (Norfolk, VA: 1985), p. 6-3.

21. The Joint Chiefs of Staff. Joint Pub 4-01.6 Joint Tactics, Techniques and Procedures for Joint Logistics Over-the-Shore (Washington: 1991), pp. VI-19, VI-20, and C-2.

22. JLOTS II Test Directorate, Analysis and Evaluation Joint Logistics Over-the-Shore II JLOTS II Throughput Test (Norfolk, VA: 1985), pp. xxvi, xxxiv, 6-3, 6-9, 6-11, and 6-15.

23. Ibid., pp. xxix, xxx, 3-32, 3-44, 3-106, 5-60, 5-76, 5-85, 5-93, 5-112, and 6-17.

24. Telephone conversation with MAJ. R. Ethridge, Department of the Army (DALO-TSM), Washington, DC, 1 Mary 1992.

25. Telephone conversation with CDR. R. McLeod, U.S. Transportation Command (TCJ3/J4 LLJ), Scott Air Force Base, IL, 1 May 1992.

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